

3.—FIBROFERRITE AND COPIAPITE FROM YETAR SPRING, NEAR CHIDLOWS.

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Yetar Spring (Lat. $31^{\circ} 56.5' S.$, Long. $116^{\circ} 21.4' E.$) is situated in the upper reaches of the Helena River some $5\frac{1}{2}$ miles S.S.E. from the junction of the main Northam and York roads (*see* W.A. Govt. Litho. 2/80).

My attention was drawn to this locality by Mr. L. Burgess of Fauldings, Ltd., Perth, who collected encrusting material from the mound built up by this spring. This material, which Mr. Burgess gave to me for determination, proved to consist largely of a mixture of fibroferrite, copiapite, and melanterite. As this occurrence of fibroferrite was the first record of this mineral for Western Australia the locality was visited by Professor Clarke and myself in April of this year, and a closer examination of the occurrence was made.

THE MOUND SPRING.

The spring, situated on flat ground, several hundred yards south of the Helena, has built up a mound $1\frac{1}{2}$ chains in diameter and about 15 feet high (fig. 1). The mound consists of a black peaty earth which is a greyish colour when dried. This material, on ignition, yields a greyish diatomaceous earth consisting entirely of diatom remains and delicate rods of amorphous silica. The latter are broken and do not show any pointed ends or a central canal and are therefore not sponge spicules—they may be silicified plant fibres. A partial analysis of this diatomaceous earth (dried at $100^{\circ}C.$) gave :—

						%
"Loss on Ignition"	...	...	...	...	...	21.85
SiO ₂	...	...	...	...	...	69.71
Fe ₂ O ₃	...	...	...	...	...	3.46
Rest	...	...	...	...	...	4.98
						100.00

Anal. : R. T. Prider.

According to the owners of this property, the mound from which the spring issues has gradually increased in size, apparently by growth from below, during the forty years that it has been known, so that several enclosing fences have been destroyed. About $1\frac{1}{2}$ chains west of the main spring there is another small spring and the ground surface over an area of about ten square yards is slightly uplifted.

The water from the spring is rich in solids (determined at 0.3077 parts per cent.) and qualitative tests indicate that chlorides are the dominant constituents with minor amounts of sulphates. The metallic ions present are mainly alkalis with lesser amounts of magnesium. No iron is present in the water, although in the channel through which the spring water runs over the surface of the mound there is a copious precipitate of flocculent iron oxide.

The sample collected by Mr. Burgess formed an encrustation on the peaty diatomite in the vicinity of the channel draining the water from the top of the

mound. It consisted of a mixture of white fibroferrite (predominant), yellow copiapite, and colourless melanterite. None of this material remained at the time of my visit in April, 1941 (possibly having been dissolved by rain, as these minerals are all water-soluble) and the only ferric sulphate minerals seen were from encrustations on the surface of small heaps of spoil from shallow holes which had been dug on the surface of the mound—such material consisted largely of copiapite and melanterite with no fibroferrite. Several samples were taken from the encrustations: (1) of moist yellow material, and (2) of dry earthy yellow material.



Figure 1.

General view of the mound at Yetar Spring. The figure on right gives the scale.

The ferric sulphate minerals are:—

A. *Fibroferrite*.—Present only in the sample collected by Mr. Burgess. It was identified optically and the determination checked by qualitative chemical tests. The properties of this mineral are:—

White in colour in the mass and soluble in cold water, the resultant solution giving positive reactions for Fe^{+++} and SO_3 only. Yields water and then SO_2 in the closed tube. Under the microscope it is seen to be in tiny colourless acicular forms with $Z \parallel$ length. $\gamma = 1.600 \pm .002$ and $\infty = 1.553 \pm .002$. These refractive indices are somewhat higher than those given by Larsen and Berman (1934, p. 103) for fibroferrite, viz., $\gamma = 1.575$ and $\infty = 1.533$.

None of the Yetar Spring fibroferrite could be obtained free from copiapite and no quantitative analysis has been made. The small lumps of white fibroferrite (about $\frac{1}{4}$ inch diameter) when broken are seen to contain a central core of copiapite.

B. *Melanterite* was identified optically from the samples collected by both Mr. Burgess and myself. My samples consisted entirely of copiapite and melanterite. In the damp material (sample 1) melanterite was more abundant than in the dry sample (No. 2) which consisted predominantly of copiapite with lesser amounts of melanterite. An estimation of ferrous iron in the moist material after drying in a desiccator over calcium chloride gave FeO

7.38 per cent. (as compared with FeO 4.50 per cent. in the naturally dry sample No. 2—see Table 1 below). The melanterite occurs as colourless weakly birefringent granules with refractive index 1.48.

C. *Copiapite* is the most abundant constituent of the naturally dried material (sample 2). It is earthy yellow material, soluble in cold water, yielding a brown acid solution. Under the microscope it is seen to be in microscopic yellow non pleochroic plates with high birefringence and $\gamma = 1.578$.

An analysis was made of the copiapite-rich sample (No. 2) and the result is shown in Table 1.

TABLE 1.

Analysis of Copiapite-rich Material (Sample 2).

Analysis on material dried in desiccator over calcium chloride for seven days.

	%	Mol. prop.	Melanterite.	Copiapite.	No. of Metal Atoms on basis of 6 S.
Insol. ⁽¹⁾ ...	0.88	...	...	...	...
FeO ...	4.50	.063	.063	...	...
Fe ₂ O ₃ ...	21.39	.134	...	.134	3.78
Al ₂ O ₃ ...	<i>Nil</i>	...	...	...	...
CaO ...	Tr.	...	...	...	...
MgO ...	1.27	.032	...	.032	0.45
K ₂ O ...	0.25	.002	...	.002	0.06
Na ₂ O ...	2.17	.035	...	.035	0.99
SO ₃ ...	39.17	.490	.063	.427	6.00
H ₂ O ⁽²⁾ ...	30.37	1.687	.441	1.246	35.10
Cl ...	Tr.	...	...	...	...
	<hr/> 100.00 <hr/>				

Anal. : R. T. Prider.

⁽¹⁾ Insoluble in cold water.

⁽²⁾ By difference. A separate determination on another sample gave "loss on ignition" 65.82 per cent.

On the assumption that all of the FeO is in the form of melanterite the residue (copiapite) has the formula (Na₂, Mg)_{0.97}(OH)_{1.94}·Fe^{'''}_{3.78}(SO₄)_{6.00}·16.58 H₂O, which agrees fairly closely with the formula X(OH)₂·Fe^{'''}₄(SO₄)₆·n H₂O suggested by Peacock (see Berry, 1939, p. 182). Following the nomenclature proposed by Berry (1939) this mineral would be a soda-magnesiocopiapite.

THE ORIGIN OF THE MOUND AND THE ASSOCIATED FERRIC SULPHATE MINERALS.

The mound surrounding the spring has apparently grown by addition of material from below. It appears most probable that the ferric sulphate minerals have been derived from a mass of pyritic material lying below the surface. The surrounding country (although outcrops are scarce in the immediate vicinity of the spring) is made up of Pre-Cambrian granitic rocks which would not be expected to contain any appreciable amount of pyrite—nevertheless pyritic masses are known to occur in the Darling Range granite, for example, at the Canning Dam quarry I have observed a well developed vein, several feet wide, of crushed granite heavily mineralised with pyrite. Again there may be a dolerite dyke carrying pyrites below the mound spring. Material derived from such a mass of decomposing pyrite has evidently been carried to the surface by the spring waters and deposited in the porous diatomite of the

mound. The ferric sulphate minerals crystallising throughout the porous diatomite would probably supply sufficient force to cause the slow uplift of the mound that has been observed.

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